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(12) **United States Patent**
Predick

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- (54) **FOOT IMPLANT FOR BONE FIXATION**
- (71) Applicant: **Life Spine, Inc.**, Huntley, IL (US)
- (72) Inventor: **Daniel Predick**, Chicago, IL (US)
- (73) Assignee: **Life Spine, Inc.**, Huntley, IL (US)

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 345 days.

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Primary Examiner — Sameh Boles
(74) *Attorney, Agent, or Firm* — Foley & Lardner LLP

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(52) **U.S. Cl.**
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(57) **ABSTRACT**

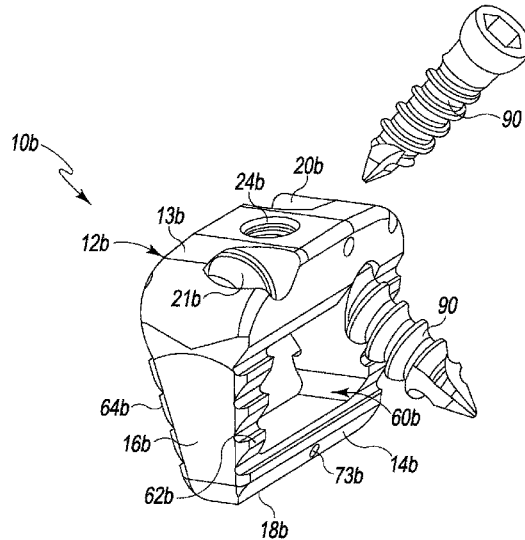
A wedge-shaped bone implant, particularly but not necessarily, for fixing bones of the foot is provided. The implant has bone screw bores that are each configured to hold a bone screw at a particular angle for receipt in a foot bone, eliminating the need to also use a plate. The implant can include an opening that extends through the implant body from one tapered side thereof to the other tapered side thereof. This opening allows the introduction and retention of bone graft material to promote bone fusion. One or both tapered sides of the body may also have teeth, serrations or the like. The implant body may include a hole or the like in the distal aspect thereof. This allows for the insertion of a metallic component (e.g. titanium or tantalum) to allow for the visibility of the extent of the implant body in radiography, x-ray, or the like.

(58) **Field of Classification Search**
None
See application file for complete search history.

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12 Claims, 8 Drawing Sheets



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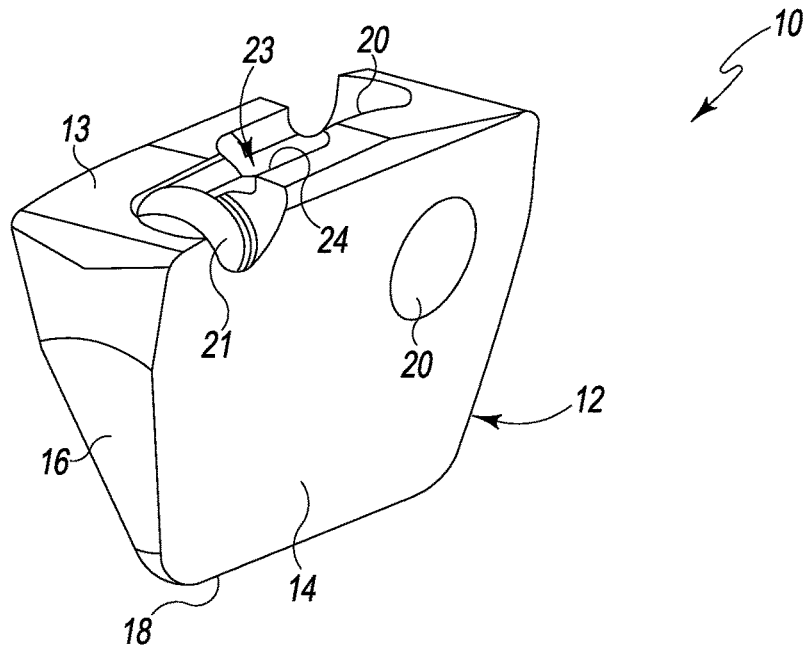


Fig. 1

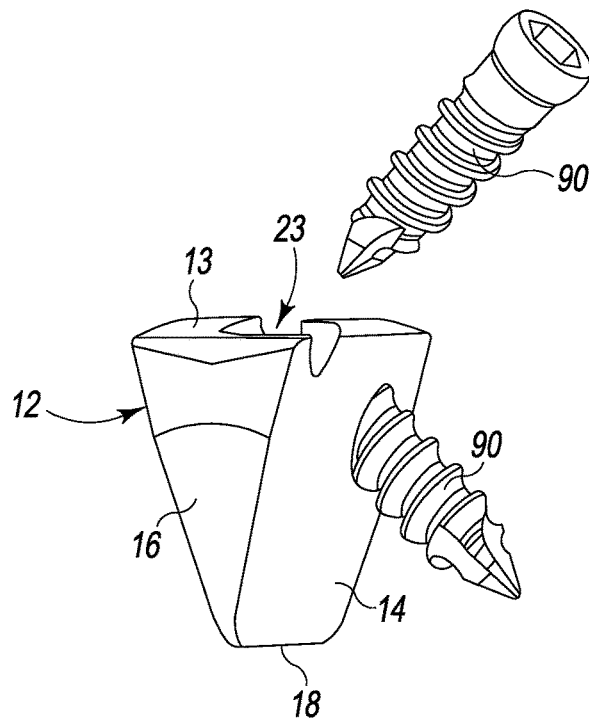


Fig. 2

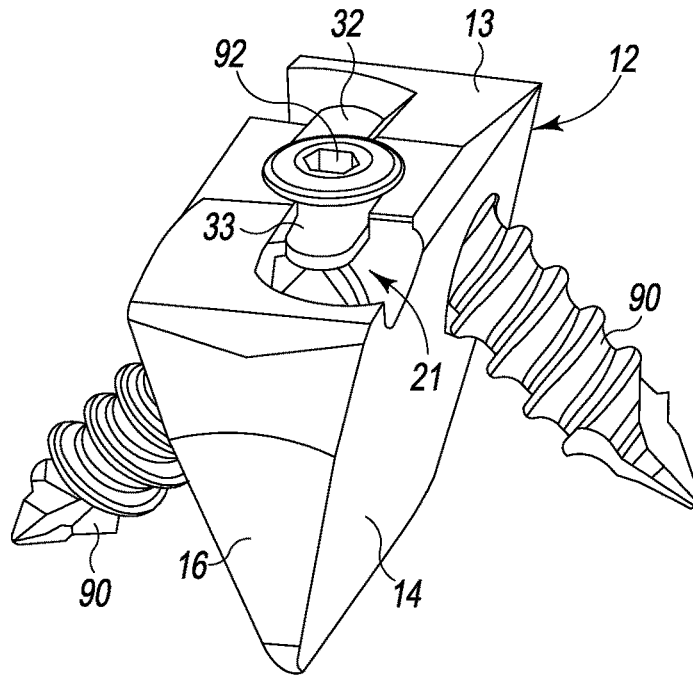


Fig. 3

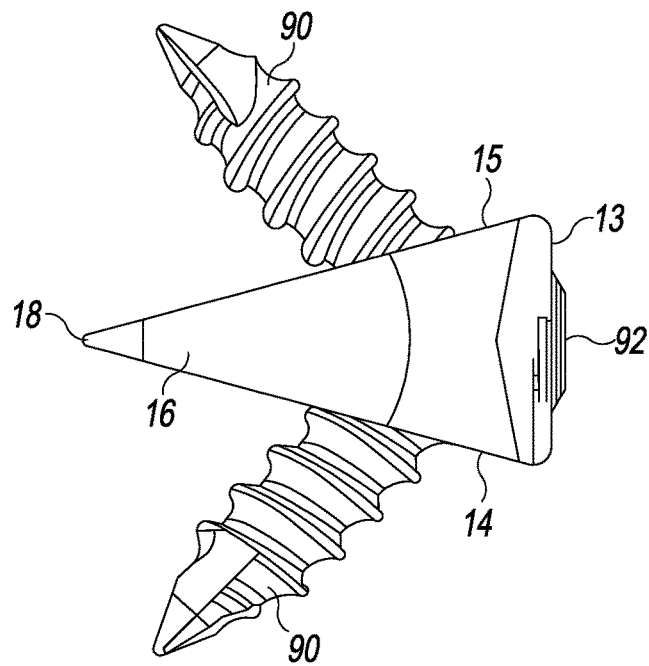


Fig. 4

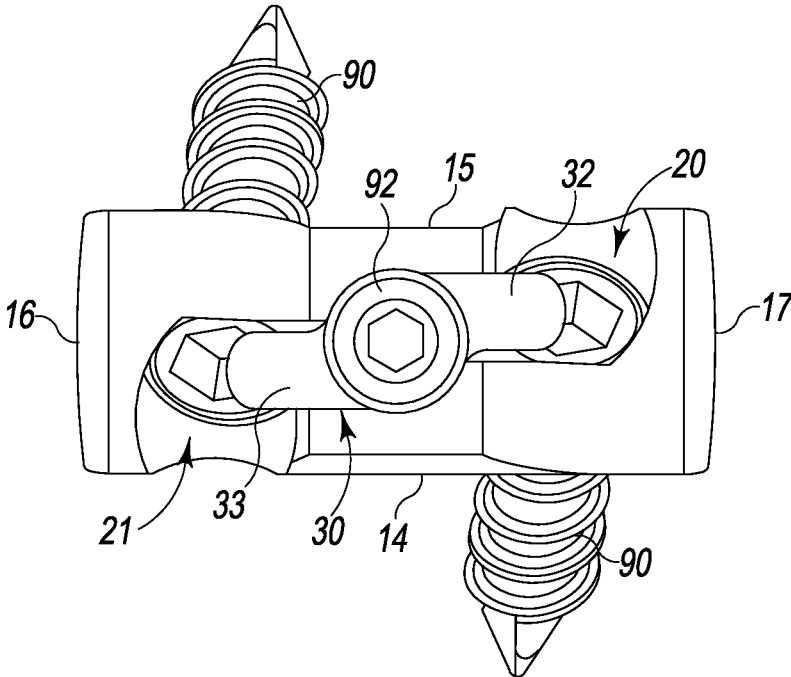


Fig. 5

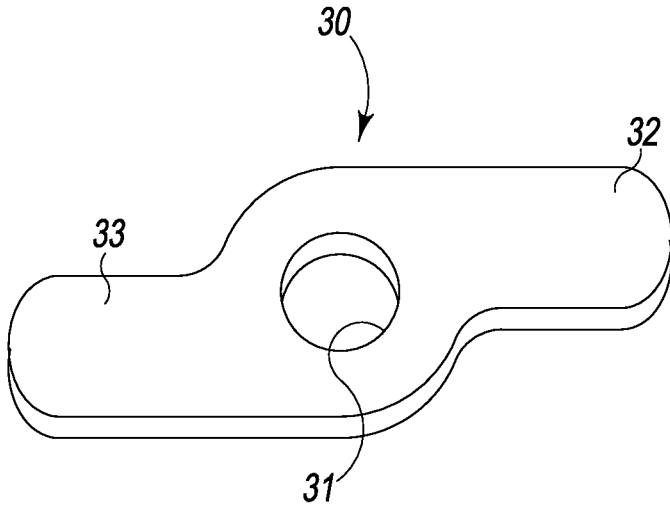


Fig. 6

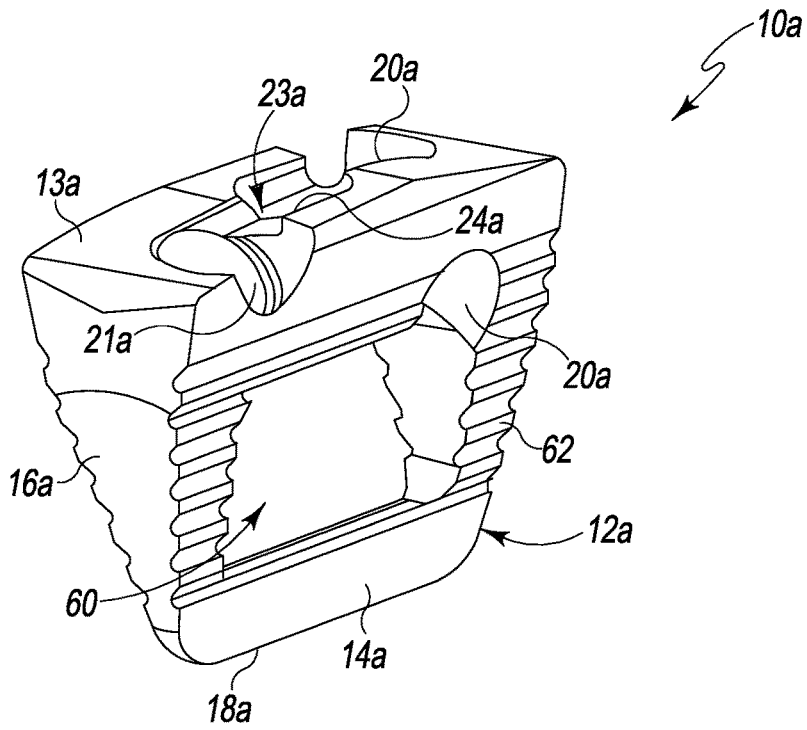


Fig. 7

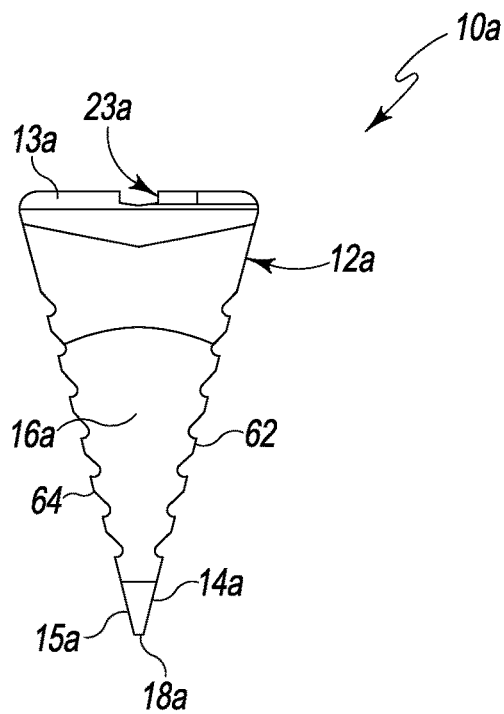


Fig. 8

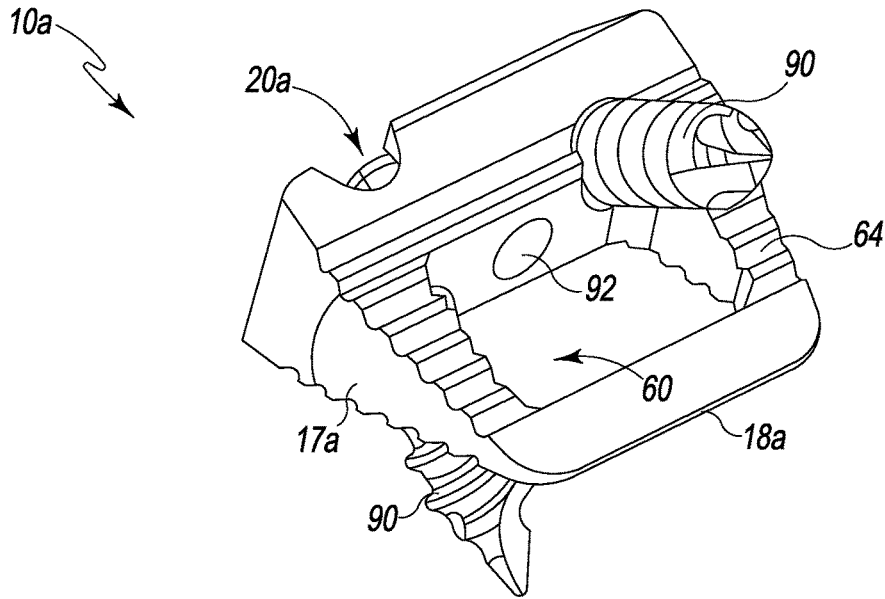


Fig. 9

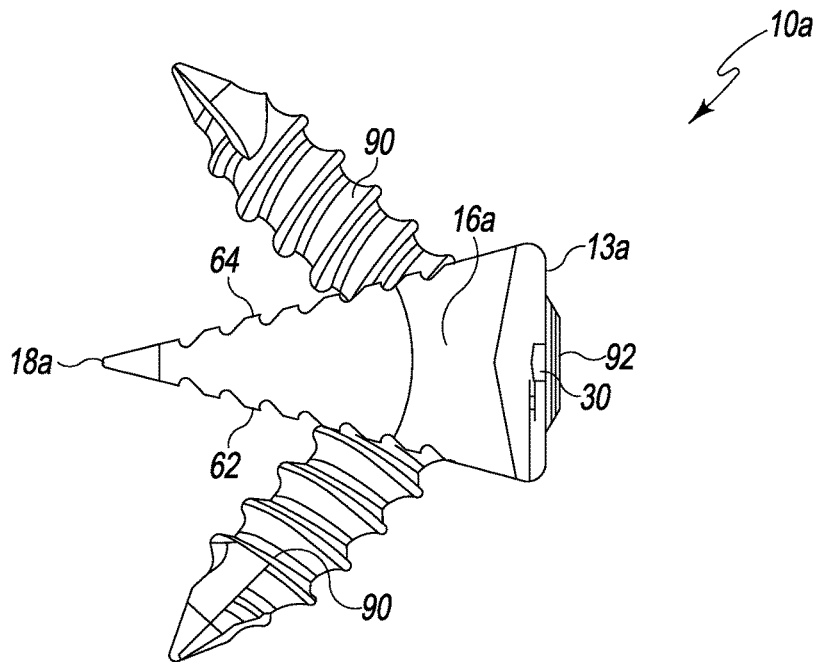


Fig. 10

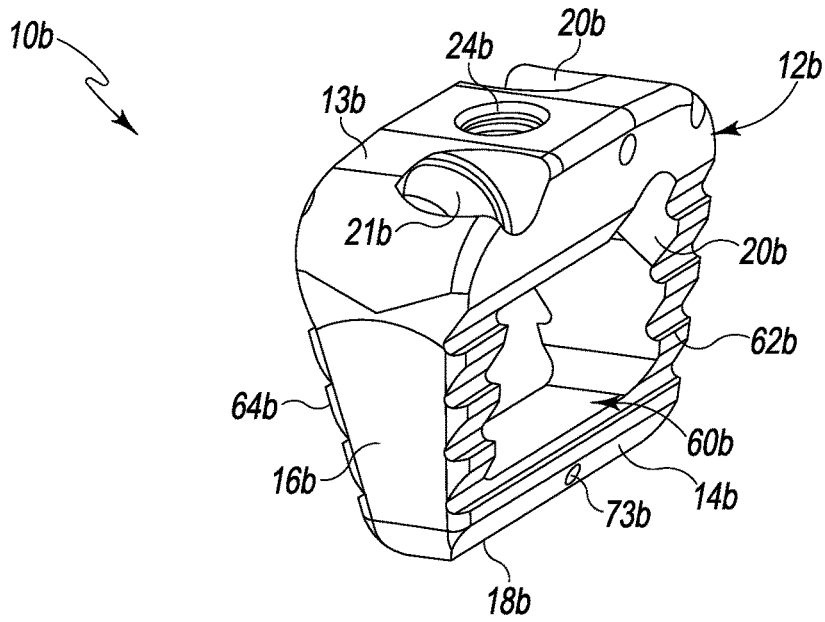


Fig. 11

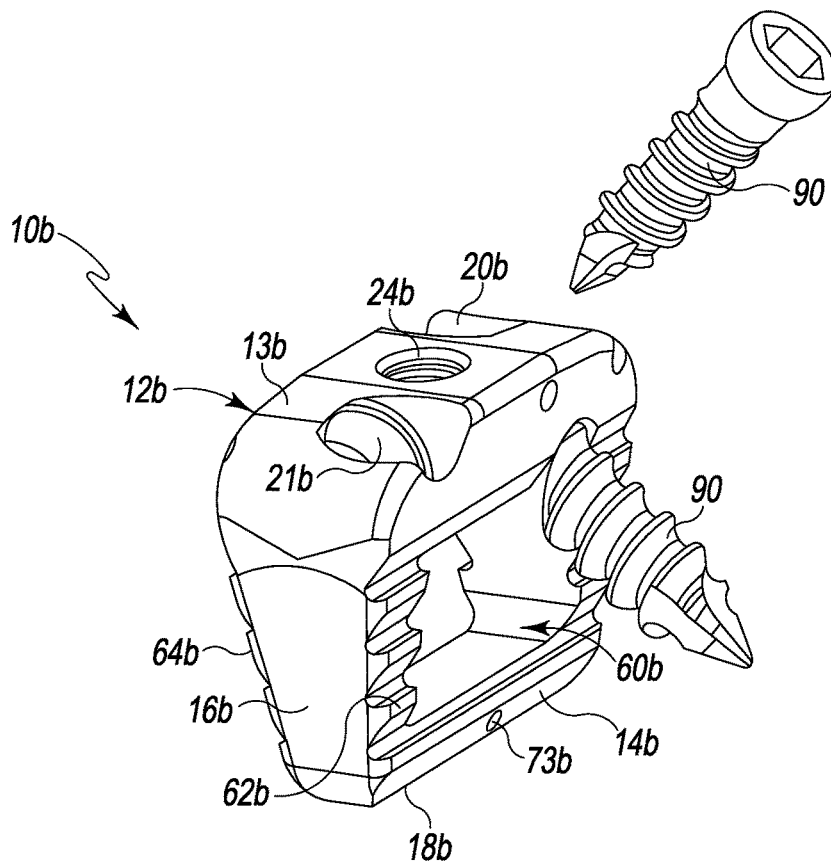


Fig. 12

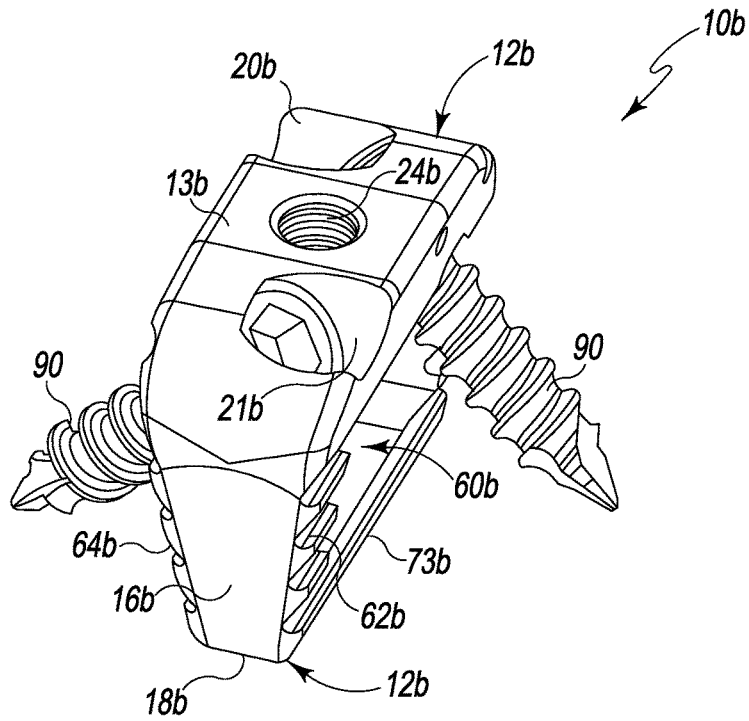


Fig. 13

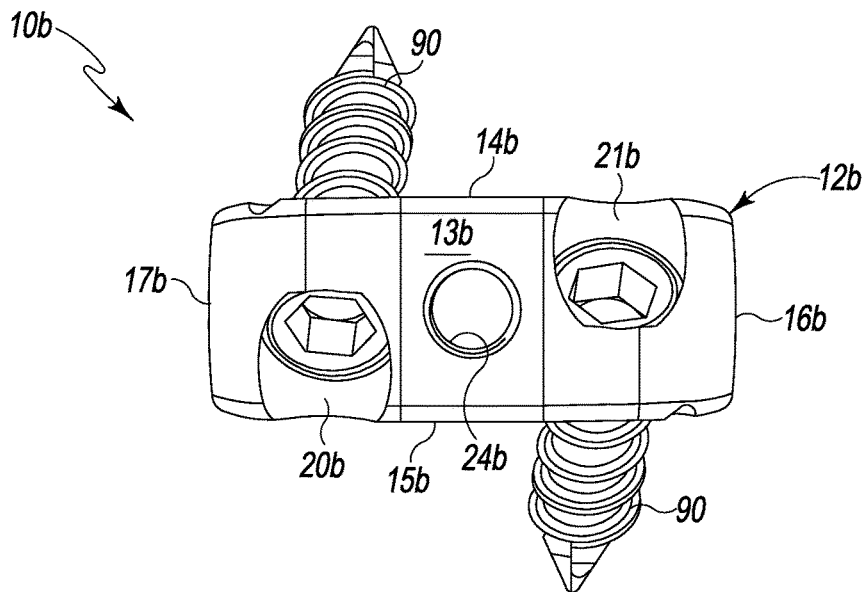


Fig. 14

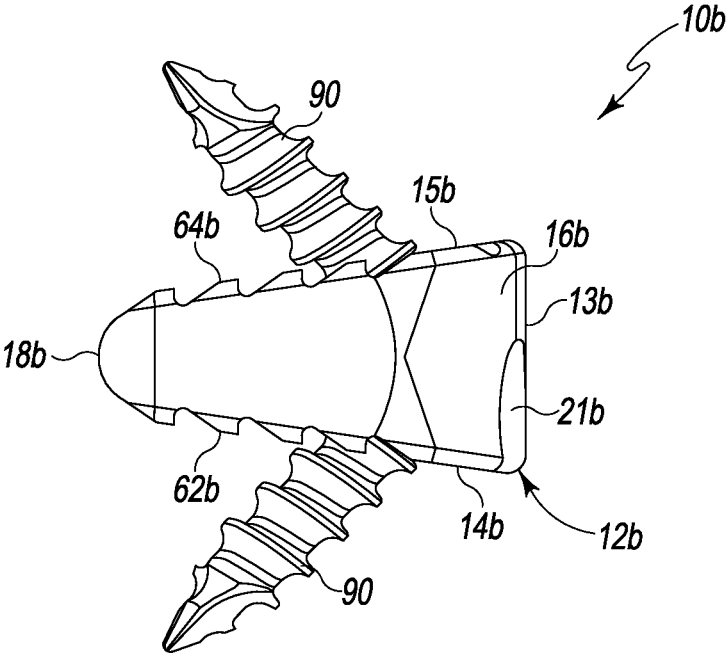


Fig. 15

FOOT IMPLANT FOR BONE FIXATION**CROSS-REFERENCE TO RELATED APPLICATIONS**

This U.S. non-provisional patent application claims the benefit of and/or priority under 35 U.S.C. § 119(e) to U.S. provisional patent application Ser. No. 61/936,644 filed Feb. 6, 2014 titled "Foot Implant For Bone Fixation," the entire contents of which is specifically incorporated herein by reference.

BACKGROUND OF THE INVENTION**Field of the Invention**

The present invention relates to implants for fixation of human bones, and particularly, to implants for fixation of bones of the foot. More particularly, the present invention relates to implants for internal fixation of calcaneus, tarsal, and metatarsal bones of the foot.

Background Information

There are many reasons why surgeries are performed on the bones of the foot. Some foot surgeries such as osteotomies are performed to correct angular deformities. Other foot surgeries are performed to mend a fracture or to re-align or reposition bones of the foot. In these surgical procedures and others, two bone portions must be joined or otherwise connected to each other so as to be fixed in a desired position and, eventually fuse. This may be accomplished by a foot bone implant.

A foot bone implant in the shape of a wedge is typically inserted between the two bone portions or into the joint. The wedge, however, has to be retained in its insertion position by a plate placed over the joint. The plate can cause irritation to the adjacent anatomy as well as to the patient.

It is therefore evident from the above that there is a need for a foot bone implant in the shape of a wedge that overcomes the deficiencies of the prior art.

SUMMARY OF THE INVENTION

The present invention is a wedge-shaped bone implant, system and method of use, particularly but not necessarily, for fixing bones of the foot. The wedge-shaped bone implant has bone screw bores that are each configured to hold a bone screw at a particular angle for receipt in a foot bone portion, thereby eliminating the need to also use a plate.

In one form, the wedge-shaped bone implant is moreover configured to receive a plate that aids in preventing a bone screw from backing out of its implant bore. The plate may be fastened to the wedge-shaped bone implant by one or more fastening screws. In this form, the top of the wedge-shaped implant has a recess that at least partially surrounds openings of the two implant bores. The recess is configured to receive the plate such that the plate at least partially obstructs the ability of a bone screw head within the implant bore to back out. Moreover, in this form, one or more of the threaded fastening screw bores for the fastening screws of the cover, may be used for engagement with an insertion instrument.

In another form, the wedge-shaped bone implant lacks a configuration on the top and thus does not accept a plate for covering the bone screws. In this case, a threaded bore may be provided for engagement with an insertion instrument instead of a threaded plate fastening screw bore.

One implant bore extends from the top of the implant body to one tapered side of the implant body, while the other

implant bore extends from the top of the implant body to the other tapered side of the implant body. When installed, one bone screw projects from one tapered side of the shaped implant body, while the other bone screw extends from the other tapered side of the implant body. One bone screw thereby projects into one foot bone portion, while the other bone screw projects into the other bone screw portion, or different foot bones.

The foot bone implant can include an opening that extends through the implant body from one tapered side thereof to the other tapered side thereof. This opening allows the introduction and retention of bone graft material in order to promote bone fusion (i.e. a graft window). One tapered side of the body may also have teeth, serrations or the like that at least partially surround the graft window. The other tapered side may likewise also have teeth, serrations or the like that at least partially surround the graft window.

In one form, the implant body includes a through hole, bore, slot or the like in the distal aspect of the implant body. This allows for the insertion of a metallic component (e.g. titanium or tantalum) to allow for the visibility of the extent of the implant body in radiography, x-ray, or the like.

The present foot bone implant is thus characterized by an implant body in the shape of a wedge, i.e., as defined in solid geometry, a right triangular prism with a rounded top, including a right oblique wedge in which the top edge is symmetrically shortened, causing the end triangles to slant obliquely (a right oblique wedge). The first bone screw bore extends from the rounded top to one slanted side of the wedge, while the second bone screw bore extends from the rounded top to the other slanted side of the wedge opposite the one side.

According to one method of use, the foot bone implant is placed into a foot bone joint to correct a deformity and provide fixation for fusion. The present foot bone implant permits the inclusion of bone screws to self-retain the wedge within the joint as well as providing stability for fusion. This is accomplished without the need for an additional plate.

According to another method of use, bone graft material is placed in the graft window of the foot bone implant. The foot bone implant with bone graft material is then placed into a foot bone joint, foot bone osteotomy site, foot bone fracture or the like and provide fixation for fusion. The foot bone implant with bone graft material permits the inclusion of bone screws to self-retain the wedge within the joint as well as providing stability for fusion. Again, this is accomplished without the need for an additional plate.

Further aspects of the present invention will become apparent from consideration of the drawings and the following description of preferred embodiments of the invention. A person skilled in the art will realize that other embodiments of the invention are possible and that the details of the invention can be modified in a number of respects without departing from the inventive concept. The following drawings and description are to be regarded as illustrative in nature and not restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

The features of the invention will be better understood by reference to the accompanying drawings which illustrate forms of the invention, wherein:

FIG. 1 is an isometric view of a wedge-shaped foot bone implant fashioned in accordance with the principles of the present invention;

3

FIG. 2 is an isometric view of the wedge-shaped foot bone implant of FIG. 1 having a bone screw situated in the foot bone implant and another bone screw ready for insertion into the foot bone implant;

FIG. 3 is an isometric view of the wedge-shaped foot bone implant of FIG. 1 having two bone screws situated therein along with a screw retention plate, forming a foot bone implant system;

FIG. 4 is an end view of the foot bone implant system of FIG. 3;

FIG. 5 is a top view of the foot bone implant system of FIG. 3;

FIG. 6 is an isometric view of the bone screw retention cover/plate of the foot bone implant system of FIG. 3;

FIG. 7 is an isometric view of another wedge-shaped foot bone implant fashioned in accordance with the principles of the present invention;

FIG. 8 is a side view of the foot bone implant of FIG. 7;

FIG. 9 is an isometric view of the foot bone implant of FIG. 8 having two bone screws situated therein;

FIG. 10 is a side view of the foot bone implant with bone screws of FIG. 9;

FIG. 11 is an isometric view of another wedge-shaped foot bone implant fashioned in accordance with the principles of the present invention;

FIG. 12 is an isometric view of the wedge-shaped foot bone implant of FIG. 11 having a bone screw situated in the foot bone implant and another bone screw ready for insertion into the foot bone implant;

FIG. 13 is an isometric view of the wedge-shaped foot bone implant of FIG. 11 having two bone screws situated therein, forming another foot bone implant system;

FIG. 14 is a top view of the foot bone implant system of FIG. 13; and

FIG. 15 is an end view of the foot bone implant system of FIG. 13.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIGS. 1-6 and, in particular FIG. 1, there is depicted a foot bone implant generally designated 10. The foot bone implant 10 is fashioned from a known biocompatible implant material and is used for aiding or providing internal fixation of calcaneus, tarsal, and metatarsal bones of the foot in cases such as, but not limited to, filling an osteotomy or expanding and correcting an angular deformity in the foot. Other uses are contemplated. The foot bone implant 10 has a generally wedge-shaped body 12 as wedges are defined in solid geometry and explained in the Summary of the Invention. As such, the body 12 has a generally rounded top 13, a generally planar first side 14, a generally planar second side 15 (see FIG. 4), a generally planar first end 16, a generally planar second end 17 (see FIG. 4), and a generally pointed bottom 18. The first and second sides 14 and 15 each slope inwardly from the top 13 to the bottom 18. The dimensions and angles of the foot bone implant 10 may be changed as desired in order to accommodate varying anatomies, purpose, and desired outcome. It should also be appreciated that the foot bone implant 10 and/or its principles are applicable to other bones of the body such as, but not limited to, the bones of the hand.

The body 12 has two bores 20, 21 each of which are dimensioned to receive a bone screw 90 such that the head of the bone screw is held by the body 12 and a portion of the tip and shank of the bone screw 90 extend from the body (see e.g., FIGS. 3-5) for receipt in a foot bone. The first bone

4

screw bore 20 extends between the top 13 and the first side 14 such that the tip of a bone screw 90 extends from the first side 14 at an angle thereof. As particularly seen in FIG. 5, the opening of the first bone screw bore 20 on the top 13 of the body 12 is situated proximate to and on the edge between the top 13 and the second side 15 creating the angled bone screw bore 20. The second bone screw bore 21 extends between the top 13 and the second side 15 such that the tip of a bone screw 90 extends from the second side 15 at an angle thereof. As again particularly seen in FIG. 5, the opening of the second bone screw bore 21 on the top 13 of the body 12 is situated proximate to and on the edge between the top 13 and the first side 14 creating the angled second bone screw bore 21. Both bone screw bore openings on the top 13 of the body 12 are sized and configured to capture and retain the head of a bone screw. Moreover, both bone screw bore openings on the top 13 are configured such that the heads of the bone screws are countersunk relative to the surface of the top 13.

A configured recess, channel, groove, depression, or the like 23 is provided in the surface of the top 13. The recess 23 is in communication with the bone screw bore openings on the top 13. Additionally, a threaded bore 24 is provided in the body 12 within the recess 23 of the top 13, the threaded bore 24 configured to receive a threaded screw or fastener 92. The recess 23 is further configured to receive a cover or plate 30. As seen in FIG. 6, the cover 30, made from a biocompatible material, has a hole 31 and first and second wings 32, 33. The cover 30 is shaped such that it fits into the recess 23. Preferably, but not necessarily, the cover 30 is shaped in similar manner to the recess 23. The cover 30 is received in the recess 23 such that the hole 31 is aligned with the threaded bore 24 in the top 13 of the body 12, with the first wing 32 extending over at least a part of the opening of first bone screw bore 20 and the second wing 33 extending over at least a part of the opening of the second bone screw bore 21. FIGS. 3 and 5 show the cover 30 mounted to the body 12 by the threaded screw 92. Two bone screws 90 are also situated in the body 12. The first wing 32 extends over or covers a portion of the bone screw head of the bone screw 90 that is in the first bone screw bore 20. The second wing 33 extends over or covers a portion of the bone screw head of the bone screw 90 that is in the second bone screw bore 21. The first and/or second wing may be shaped to extend over more of the bone screw head than shown. Because the wings are over the bone screw heads, this prevents the bone screw from backing out of the bone screw bore.

Referring to FIGS. 7-10, there is depicted a foot bone implant, generally designated 10a, being a variation of the foot bone implant 10. As such, the foot bone implant 10a is thus fashioned in a generally like manner to the foot bone implant 10, with the like features and/or components denoted by the addition of the letter "a" to the feature and/or component of the foot bone implant 10. Because these features and/or components are the same, they will not be discussed in detail. Reference should therefore be made to the foot bone implant 10 for details.

As best seen in FIGS. 7 and 9, the foot bone implant body 12a has an opening 60 that extends from the one tapered or slanted side 14a to the other tapered or slanted side 15a. While the opening 60 is shown as rectangular, it should be appreciated that the opening 60 may be configured as desired. The opening 60 is used to receive and hold bone graft material. As such, the opening 60 may be considered a bone graft window or simply a graft window. The bone graft material may be of any kind. Moreover, the graft window may comprise two or more openings that each extend from

5

the one tapered or slanted side **14a** to the other tapered or slanted side **15a**. These graft openings can be shaped as desired.

As seen in FIGS. **9** and **10**, the two bone screws **90** are shown situated in the body **12a** such as they would appear when implanted. The bone screw cover **30** is within the top recess **23a** and fastened to the body **12a** via the fastener **92**. As per the foot bone implant **10**, portions of the cover **30** extend over the bone screw heads in order to prevent the bone screws from backing out.

In addition to the bone graft window **60**, the body **12a** has features for aiding in and/or promoting fusion between two foot bones or foot bone portions. These features also aid in keeping the body **12a** in place. Particularly, a portion of the one tapered or slanted side **14a** has teeth, serrations or the like **62**, while a portion of the other tapered or slanted side **15a** likewise has teeth, serrations or the like **64**. The teeth **62** surround the graft window **60** or at least are present about the top and sides of the graft window **60** in the slanted side **14a**. Likewise, the teeth **64** surround the graft window **60** or at least are present about the top and sides of the graft window **60** in the slanted side **15a**. The upper portions of the slanted sides **14a** and **15a** proximate the top **13a** and the lower portions of the slanted sides **14a**, **15a** proximate the bottom **18a** preferably, but not necessarily, lack teeth, serrations, or the like.

Referring to FIGS. **11-15**, there is depicted a foot bone implant, generally designated **10b**, being a variation of the foot bone implants **10** and/or **10a**. As such, the foot bone implant **10b** is thus fashioned in a generally like manner to the foot bone implants **10**, **10a**, with the like features and/or components denoted by the addition of the letter “b” to the feature and/or component of the foot bone implants **10**, **10a**. Because these features and/or components are the same, they will not be discussed in detail. Reference should therefore be made to the foot bone implants **10**, **10a** for details.

As best seen in FIGS. **11-13**, the foot bone implant body **12b** has an opening **60b** that extends from the one tapered or slanted side **14b** to the other tapered or slanted side **15b**. While the opening **60b** is shown as rectangular, it should be appreciated that the opening **60b** may be configured as desired. The opening **60b** is used to receive and hold bone graft material. As such, the opening **60b** may be considered a bone graft window or simply a graft window. The bone graft material may be of any kind. Moreover, the graft window may comprise two or more openings that each extend from the one tapered or slanted side **14b** to the other tapered or slanted side **15b**. These graft openings can be shaped as desired.

As seen in FIGS. **13-15**, the two bone screws **90** are shown situated in the body **12b** such as they would appear when implanted. In addition to the bone graft window **60b**, the body **12b** has features for aiding in and/or promoting fusion between two foot bones or foot bone portions. These features also aid in keeping the body **12b** in place. Particularly, at least a portion or more of the one tapered or slanted side **14b** has teeth, serrations or the like **62b**, while at least a portion or more of the other tapered or slanted side **15b** likewise has teeth, serrations or the like **64b**. The teeth **62b** surround the graft window **60b** or at least are present about the top and sides of the graft window **60b** in the slanted side **14b**. Likewise, the teeth **64b** surround the graft window **60b** or at least are present about the top and sides of the graft window **60b** in the slanted side **15b**. The upper portions of the slanted sides **14b** and **15b** proximate the top **13b** and the lower portions of the slanted sides **14b**, **15b** proximate the bottom **18b** preferably, but not necessarily, lack teeth, ser-

6

rations, or the like. It should be appreciated that any pattern of teeth, direction of teeth, and/or dimensions of teeth may be used.

As best seen in FIGS. **11-14**, the top **13b** of the implant body **12b** lacks a configuration on the top for a cover and thus does not accept a plate for covering the bone screws like foot implants **10** and **10a**. In this case, a threaded bore **24b** may be provided for engagement with an insertion instrument (not shown) instead of a threaded plate fastening screw bore.

As best seen in FIGS. **11-12**, the implant body **12b** includes a through hole, bore, slot or the like **73b** in the distal aspect **18b** of the implant body **12b**. This allows for the insertion of a metallic component such as titanium or tantalum (not shown) to allow for the visibility of the extent of the implant body in radiography, x-ray, or the like.

It should be appreciated that although the present bone fixation device has been shown in the figures and described above in particularity with respect to bones of the foot, such is applicable to bones of the hand; those bones being very similar in anatomy. It should also be appreciated that dimensions of the body and its features and/or components can be changed as desired.

What is claimed is:

1. A foot bone implant comprising:

- a wedge-shaped body defining an elongated top, a first slanted side, a second slanted side opposite the first slanted side, a first lateral end, a second lateral end opposite the first lateral end, and a bottom that is narrower in width than the elongated top, the first slanted side extending from a first elongated side of the elongated top to a first elongated side of the bottom, the second slanted side extending from a second elongated side of the elongated top to a second elongated side of the bottom, the first lateral side extending from a first lateral side of the elongated top to a first lateral side of the bottom, and the second lateral side extending from a second lateral side of the elongated top to a second lateral side of the bottom;
- a first bore extending from the second slanted side to: the first slanted side, the first lateral end, the elongated top, and the first lateral side of the elongated top proximate the first elongated side of the elongated top; and
- a second bore extending from the first slanted side to: the second slanted side, the second lateral end, the elongated top, and the second lateral side of the elongated top proximate the second elongated side of the elongated top;
- a hole extending from the first slanted side, the hole is configured to allow for the insertion of a metallic component visible in radiography or x-ray.

2. The foot bone implant of claim 1, further comprising an opening between the first slanted side and the second slanted side such that the first bore extends from both the second slanted side and the opening, and the second bore extends from both the first slanted side and the opening.

3. The foot bone implant of claim 2, wherein the first slanted side has serrations.

4. The foot bone implant of claim 3, wherein the second slanted side has serrations.

5. A method of joining two foot bone portions comprising the steps of:

- providing a foot bone implant according to claim 1;
- providing two bone screws;
- implanting the foot bone implant according to claim 1 between two foot bone portions; and

7

securing the foot bone implant to the two foot bone portions via the two bone screws.

6. The foot bone implant of claim 1, wherein the top comprises a threaded bore extending into the wedge-shaped body.

7. The foot bone implant of claim 6, wherein the threaded bore is configured for engagement with an insertion instrument.

8. The foot bone implant of claim 1, wherein the hole is a through hole extending from the first slanted side to the second slanted side proximate the bottom.

9. A foot bone implant system comprising:
a wedge-shaped body defining an elongated top, a first slanted side, a second slanted side opposite the first slanted side, a first lateral side, a second lateral side opposite the first lateral side, and a bottom that is narrower in width than the elongated top, the first slanted side extending from a first elongated side of the elongated top to a first elongated side of the bottom, the second slanted side extending from a second elongated side of the elongated top to a second elongated side of the bottom, the first lateral side extending from a first

8

lateral side of the elongated top to a first lateral side of the bottom, and the second lateral side extending from a second lateral side of the elongated top to a second lateral side of the bottom;

5 a first bore extending from the first lateral side of the elongated top proximate the first elongated side of the elongated top to the second slanted side;

a second bore extending from the second lateral side of the elongated top proximate the second elongated side of the elongated top to the first slanted side;

a hole extending from the first slanted side, the hole is configured to allow for the insertion of a metallic component visible in radiography or x-ray; and first and second bone screws.

10 10. The foot bone implant system of claim 9, with further comprising an opening between the first slanted side and the second slanted side.

11. The foot bone implant system of claim 10, wherein the first slanted side has serrations.

20 12. The foot bone implant system of claim 11, wherein the second slanted side has serrations.

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